

Descriptions of three new species of *Californidorus* from Arkansas and the male of *C. pinguicaudatus* (Nematoda : Dorylaimida)⁽¹⁾

Robert T. ROBBINS

Department of Plant Pathology, PS 217, University of Arkansas, Fayetteville, AR 72701, USA.

SUMMARY

Californidorus clavicaudatus n. sp., *C. cralleyi* n. sp., and *C. cylindricaudatus* n. sp. are described from Arkansas, USA. A male of *C. pinguicaudatus* is described from the type locality in California, USA. Females of the three Arkansas species differ from females of *C. pinguicaudatus* by: the presence of one, two or three ventral pores just posterior to the vulva; having a reduced anterior genital branch with a uterus, sphincter, and incomplete ovary-oviduct. *Californidorus clavicaudatus* n. sp. is distinguished from all the other *Californidorus* species by the common occurrence of males and the spermatheca in females containing sperm. Females of *C. clavicaudatus* n. sp. differ from those of *C. cylindricaudatus* n. sp. and *C. cralleyi* n. sp. by the expanded tail region. Females of *C. cralleyi* n. sp. can be distinguished from the other species by its more posterior vulva.

RÉSUMÉ

Description de trois nouvelles espèces de *Californidorus* provenant de l'Arkansas et du mâle de *C. pinguicaudatus* (Nematoda : Dorylaimida)

Californidorus clavicaudatus n. sp., *C. cralleyi* n. sp. et *C. cylindricaudatus* n. sp., provenant de l'Arkansas, USA, sont décrits. Un mâle de *C. pinguicaudatus* provenant de la localité type, en Californie, USA, est également décrit. Les femelles des trois nouvelles espèces diffèrent de celles de *C. pinguicaudatus* par: la présence d'un à trois pores ventraux immédiatement postérieurs à la vulve; la branche génitale antérieure réduite comportant utérus, sphincter et un ovaire-oviducte incomplet. *C. clavicaudatus* n. sp. se distingue de toutes les autres espèces du genre par l'abondance des mâles et la présence de spermatozoïdes chez les femelles. Les femelles de *C. clavicaudatus* n. sp. diffèrent de celles de *C. cylindricaudatus* n. sp. et de *C. cralleyi* n. sp. par la région caudale renflée. Les femelles de *C. cralleyi* n. sp. diffèrent de celles des autres espèces par la position postérieure de la vulve.

In July 1978, many additional specimens of *Californidorus pinguicaudatus* Robbins & Weiner, 1978 were recovered from the type locality in California. The first-stage juveniles with spiked tails were described from these specimens (Robbins, 1980). Along with many females and all juvenile stages a single male was found and is described.

Many specimens of a similar species including all juvenile stages and females were found in October 1979, in soil five miles upstream from Lake Sequoyah, Washington County, Arkansas, and are described herein. Two more populations of this new species were found in Arkansas, one on the bank of Dick's Branch near Ludwig, Johnson County, the other in Fayetteville, Washington County. Each of these three populations are located on different watersheds.

Also in October 1979, two composite soil samples containing a few specimens of the above new species and a second new species were found. The samples were taken about 1 km apart in the same creek bottom in Johnson County, Arkansas. In June 1983, a pure population of all juvenile stages and adults of both sexes of this second species was found nearby and described herein.

A third new *Californidorus* sp. was found on the Pine Tree Experiment Station, St. Francis County, Arkansas, in October 1982. Females and all juvenile stages were found and are described herein.

Materials and methods

Specimens were extracted by sieving-mist extraction in California and either sieving-direct examination or

(1) Published with approval of the Director of the Arkansas Experiment Station.

sieving-Baermann funnel in Arkansas. Specimens were killed and fixed by hot 2 % formalin and processed to glycerin by a modified Seinhorst rapid method described by Robbins (1978).

Taxonomy and morphology of the genus *Californidorus*

Robbins and Wiener (1978) proposed the genus *Californidorus* and placed it in the family Longidoridae, sub-family Californidorinae. They reported that anterior sub-ventral nuclei (SN₁) were not present in the enlarged basal (EB) portion of the esophagus and that the odontophore base was expanded and slightly sclerotized. The presence of sclerotized pieces surrounding the proximal end of the vagina was not mentioned. They proposed synonymizing Xiphinematinae with Longidorinae.

Jairajpuri (1982) in his study of *Californidorus* compared it to representatives of the following genera: *Longidorus*, *Paralongidorus*, *Xiphinema*, *Pungentus*, and *Enchodelus*. He reported that in *Californidorus* SN₁ are present although poorly developed; the vaginal wall is sclerotized; and that the odontophore is surrounded by ellipsoidal swelling (not flanged). Because of these observations he concluded that *Californidorus* is not a member of the family Longidoridae and proposed placing it in the family Nordiidae, sub-family Pungentinae; and also proposed that Californidorinae be synonymized with Pungentinae.

Siddiqi (1983) states (p. 122) "On the basis of its elongate basal bulb with five gland nuclei, slightly sclerotized vagina, anteriorly placed stylet guiding ring and a non-offset dorylaimoid base of the odontophore, *Californidorus* does not belong to the Longidoroidea and should be placed in the Pungentidae, although its odontostyle is as long as in *Xiphinema*." In the illustration on the previous page he places *Enchodelus*, *Californidorus*, and *Xiphinema* in the Longidoroidea. This seems to be a direct contradiction to his quoted statement above.

Coomans (1985) compared the described genera of Longidoridae to one another and to their closest relatives, the Nordiidae. He considers *Californidorus* to be Nordiidae. He makes several observations on the anterior region of *C. pinguicaudatus* and makes comparisons to the Longidorids.

In recent studies of all the developmental stages of the four *Californidorus* spp. (*C. pinguicaudatus* and the three new species described herein) the following observations were made: there is a definite « granular » appearing area about mid-way in the EB, there is an expanded lightly sclerotized odontophore base which is set off from the thin tubular part of the esophagus, and the proximal end of the vagina has definite heavily sclerotized « plates » both anterior and posterior to the vagina in most specimens. The observed « granular »

area, while assumed to be anterior sub-ventral glands (ASVG), is quite large and extends 20-30 % of the EB. Jairajpuri (1982) depicts this in an illustration without comment. In none of the specimens were definite SN₁ observed, in a few instances small obscure structures were observed with the « granular » area. Whether these structures were SN₁ or artifacts is not certain. Differential nuclear staining and/or transmission electron microscope studies of this region similar to those of Robertson and Wyss (1979) would be helpful in determining the presence or absence of SN₁ and whether the large granular areas are truly the ASVG.

The obvious heavily sclerotized « plates » found anterior to and posterior to the vagina were observed in specimens of the above four species, though not consistently in one species. Each species seems to have « plates » of a definite shape and size. In some of the specimens of one species the « plates » were not observed. Their absence may be due to fixation or age of the specimens. The « plates » are assumed to be what Jairajpuri called the sclerotized vagina.

The odontophore base is definitely expanded and set off from the thin tubular part of the esophagus. The odontophore base has protractor muscles attached to it and appears as lightly sclerotized flanges. The odontophore base is not rod-like as illustrated for *Pungentus clavatus* Ahmad & Jairajpuri, 1979. The flanges appear similar to those of *Enchodelus* spp. as described by Ahmad and Jairajpuri (1980). Again, transmission electron microscope studies of the odontophore base similar to those of Roggen, Raski and Jones (1967), Robertson (1975), and Taylor and Robertson (1971) are needed to be certain of the structural differences between *Californidorus*, *Pungentus*, *Enchodelus*, *Xiphinema*, *Longidorus*, *Xiphidiorus* and other closely related genera.

While Jairajpuri (1982) proposed that Xiphinematinae be re-established, he did not address the issues as stated by Robbins and Wiener (1978) namely that of the in-between positions of *Xiphidiorus* and numerous other species and only eluded to Californidorinae and its proposed inclusion in the Longidoridae. It is my observation that the major differences between Nordiidae and Longidoridae are: the EB of Longidoridae is « set off » from the « the tubular region » much more sharply than in the Nordiidae, the presence or absence of sclerotized vaginal walls « plates », and the presence or absence of SN₁ and SN₂. The latter argument is variable and controversial because of the lack of direct substantiation or rejection of many written descriptions and illustrations. The first argument however is definitive, the esophagus either is or is not « set off ». The presence or absence of sclerotized vaginal walls « plates » is variable in *Californidorus*. Because the esophagus of *Californidorus* is not « set off » it probably belongs to the Nordiidae. However the separation of Nordiidae and Longidoridae is not clear cut because some of the characters overlap. It is generally agreed that Nordiidae

and Longidoridae are closely related (Ferris, 1971; Andr assy, 1976; Siddiqi, 1983; Coomans, 1985). However, until basic morphological comparisons are made with the transmission electron microscope of certain selected members of these groups there will be lingering doubts as to the higher taxonomic position of all members of these closely related groups.

Californidorus pinguicaudatus

Robbins & Wiener, 1978

(Fig. 1)

MEASUREMENTS

Male (n = 1): length = 2.00 mm; a = 46.6; b = 4.2; c = 62.6; c' = 0.73; odontostyle = 100 μ m; odontophore = 74 μ m; anterior end to guide ring distance (GR) = 46 μ m; spicules length (along chord) = 53 μ m; width at mid body = 43 μ m; esophagus length (esoph.) = 476 μ m; basal portion of esophagus length (EBL) = 200 μ m; basal portion of esophagus width (EBW) = 24.5 μ m; tail length (tail) = 32 μ m; distance to dorsal gland nucleus as a percentage of EBL (DN) = 21 %; distance to the most anterior sub-ventral gland nucleus

as a percentage of EBL (ASVGN) = 82 %; distance to posterior subventral gland nucleus as a percentage of EBL = 83 %; no. supplements = 13 single + an adanal pair.

DESCRIPTION

Male: Relaxed specimen similar to female in anterior 80 %, posterior 20 % a tighter spiral. Testes, two, opposed. Supplements 3-8 μ m apart. Distance from cloaca to first ventromedian supplement 9 μ m. Three caudal pores, two at level of cloaca, one mid tail. Tail bluntly rounded.

TYPE HABITAT, HOST AND LOCALITY

This is the type locality for the species. Soil from around the roots of "giant reed" (*Arundo donax* L.), Portergulch Road, near Soquel, Santa Cruz County, California.

SLIDE DEPOSITED

Author's collection, University of Arkansas.

Californidorus clavicaudatus n. sp.*

(Fig. 2)

MEASUREMENTS

Females: see Table 1.

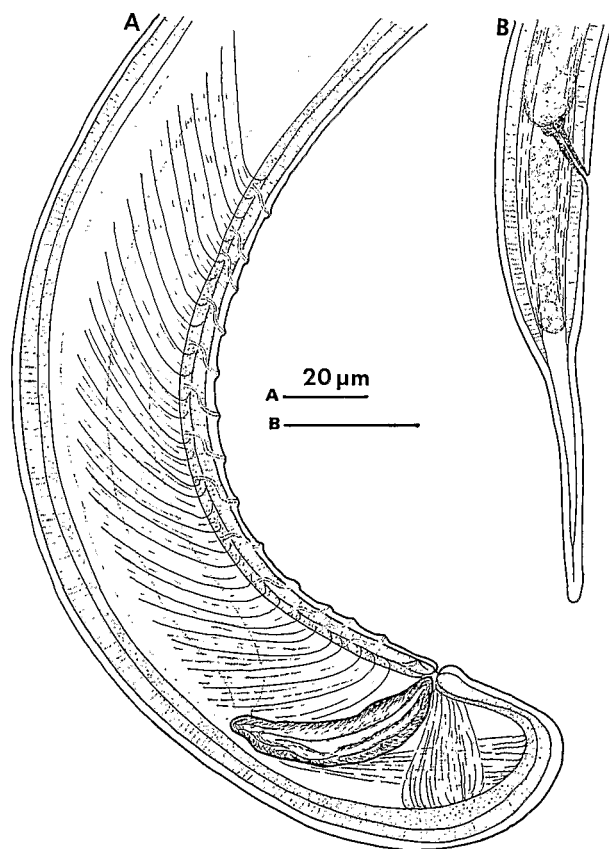
Males: see Table 2.

Juveniles: see Table 3.

Holotype (female). L = 2.56 mm; a = 46.9; b = 4.73; c = 101.7; c' = 0.61; V = 35.5; odontostyle = 101 μ m; odontophore = 32 μ m; GR = 38 μ m; anterior genital branch length (G₁) = 235 μ m; posterior genital branch length (G₂) = 428 μ m; body at vulva (width) = 54.5 μ m; esoph. = 542 μ m; tail = 25 μ m; anal body width (ABW) = 41 μ m; EBL = 239 μ m; EBW = 25 μ m; DN = 15.8 %; ASVGN = 82.5 %.

DESCRIPTION

Female: Body stout, ventrally curved, "C" to "J" shape when killed slowly by adding hot 2 % formalin. Lip region about half as high as wide, rounded, offset. Guide ring single, about three lip region widths from



◀ Fig. 1. *Californidorus pinguicaudatus* Robbins & Wiener, 1978. Tails. A: Male; B: First-stage juvenile.

* The species name *clavicaudatus* is Latin derived from *clava* = club and *cauda* = tail.

anterior end. Stylet long, in two parts; odontostyle base forked at junction with odontophore; base of odontophore expanded, moderately sclerotized. Nerve ring about mid-way between odontophore base and expanded esophagus base. Expanded basal portion of esophagus typical for genus. Vulva a transverse slit. Sclerotized vulval "plates" anterior and posterior to vagina may be indistinct. Two or three ventral pores just posterior to vulva. Anterior genital branch reduced, with sphincter at the anterior end of the uterus, greatly reduced terminal oviduct, and no ovary. Anterior and posterior uteri expanded, often containing sperm. Posterior genital branch reflexed near posterior end of oviduct, sac connecting the ovary and oviduct extends posterior from junction. Tail expanded bluntly rounded, hemispherical, with one latero-dorsal caudal pore.

Male : Similar to female in anterior 80 %, posterior 20 % a much tighter spiral. Testes, two, opposed. Supplements ventromedian 15-18 in a single row 3-9 μm apart, 8-10 μm from cloaca to first, with an additional adanal pair. Guide pieces inconspicuous. Three caudal

pores, two at cloaca level, one mid tail. Tail blunt, with enlarged ventral knob-like process.

Juveniles : All stages similar to females, except : presence of replacement stylets; smaller; presence of a germinal primordia; and J1 tail with a "spike".

TYPE LOCALITY AND HABITAT :

The bank of Dicks Branch one mile north, one mile east of Ludwig, Johnson County, Arkansas, USA. Sandy soil about the roots of willow (*Salix* sp.) and sweet gum (*Liquidambar styraciflua* L.). Found also about 25 m north of the type location about the roots of grape (*Vitis* sp.) and hackberry (*Celtis* sp.); and about 1 km upstream in the creek bed.

TYPE SPECIMEN

Holotype : Female : Collected June 1983 by R. T. Robbins. Deposited on slide number UCNC 2007 University of California Davis Nematode Collection, Davis, California.

Table 1

Biometrics of *Californidorus clavicaudatus* n. sp. females.

Measurement or ratio*	Paratypes, Willow and Sweet Gum (n = 5)	Populations Hackberry and Grape (n = 10)	Composite Soil Sample Upstream n = 4)
L (μm)	2548 (2323-2759)**	2381 (2091-2539)	2515 (2367-2641)
a	48.7 (45.1-53.2)	47.8 (43.1-52.0)	52.9 (50.7-54.5)
b	4.84 (4.50-5.21)	4.67 (4.18-4.95)	4.90 (4.60-5.30)
c	90.2 (79.0-106.3)	91.8 (81.5-103.3)	96.7 (94.7-97.8)
c'	0.70 (0.60-0.79)	0.65 (0.58-0.76)	0.65 (0.61-0.68)
V	35.4 (32.9-37.2)	36.9 (34.4-38.3)	36.2 (34.2-37.0)
Lip W (μm)	14.5 (14.0-15.0)	14.6 (13.7-14.7)	14.6 (14.2-14.7)
GR (μm)	39.5 (38.0-41.0)	39.9 (37.8-42.0)	38.5 (37-41)
Odontostyle (μm)	102 (96-105)	103.4 (97.7-108.2)	101.0 (100-103)
Odontophore (μm)	84 (82-88)	84.8 (81.9-88.2)	83.3 (80-88)
EBL (μm)	229 (212-242)	223 (213-229)	219 (200-234)
EBW (μm)	23.5 (21.0-25.2)	24.5 (21.0-27.3)	24.6 (24.0-26.0)
Esoph. (μm)	526 (496-542)	517 (483-538)	527 (502-544)
Dist. to vulva (μm)	902 (806-981)	878 (788-938)	911 (833-975)
Ant. gonad length (μm)	233 (217-244)	226 (187-288)	253 (218-286)
Post. gonad length (μm)	401 (378-447)	393 (347-462)	394 (373-428)
Vaginal depth (μm)	31.0 (29.5-32.5)	29.5 (27.3-31.5)	23.8 (30.5-34.7)
Width at vulva (μm)	52.3 (50.4-54.6)	49.9 (48.3-52.5)	47.5 (45-49)
Tail (μm)	28.5 (25.2-32.6)	26.0 (24.2-29.4)	26.0 (25-27)
Width at anus (μm)	41.0 (39.9-42.0)	40.4 (38.9-42.0)	40.1 (38.5-41.0)
DN (%)	15.2 (14.1-16.7)	17.4 (15.9-19.7)	16.4 (15.5-17.7)
ASVGN (%)	82.3 (80.0-84.2)	82.2 (80.8-83.9)	73.8 (67.3-79.2)

* For abbreviations see text.

** Mean is given first followed by range in parentheses.

Table 2
Biometrics of *Californidorus clavicaudatus* n. sp. males.

Measurement or ratio*	Paratypes, Willow and Sweet Gum (n = 8)	Populations Hackberry and Grape (n = 9)	Composite Soil Sample (n = 5)
L (µm)	2550 (2205-2720)**	2411 (2085-2678)	2342 (2220-2553)
a	52.5 (49.2-57.6)	50.8 (45.1-57.5)	55.6 (53.2-59.3)
b	4.88 (4.53-5.30)	4.82 (4.30-5.72)	4.72 (4.40-5.00)
c	90.9 (82.5-99.6)	90.1 (83.7-106.6)	86.1 (82.2-91.2)
c'	0.65 (0.63-0.66)	0.63 (0.55-0.66)	0.65 (0.64-0.67)
T	65.0 (57.5-68.2)	62.3 (56.7-68.9)	62.7 (61.6-64.5)
Lip W (µm)	14.7 (14.7-14.7)	14.7 (14.7-14.7)	14.2 (12.6-14.7)
GR (µm)	39.2 (38.9-39.9)	39.4 (36.8-41.0)	35.9 (35.0-37.0)
Odontostyle (µm)	104.7 (100.8-109.2)	101.7 (94.5-109.2)	98.4 (97.0-100.0)
Odontophore (µm)	84.5 (81.9-87.2)	81.4 (77.7-86.1)	81.4 (77.0-85.0)
EBL (µm)	218 (202-235)	210 (193-227)	207 (195-213)
EBW (µm)	21.5 (22.1-26.3)	24.6 (22.1-27.3)	24.2 (22.1-26.3)
Esoph. (µm)	522 (487-542)	501 (468-536)	510 (487-523)
Dist. to testes (µm)	873 (814-937)	907 (830-1065)	873 (844-907)
Widest width (µm)	48.6 (44.1-51.5)	47.6 (44.1-52.5)	46.4 (42.0-52.5)
Spicule length (µm)	53.8 (52.5-56.7)	53.0 (51.5-54.6)	54.4 (52.5-56.7)
Supplement number	16.4 (15-19)	16.1 (14-17)	15.8 (15-18)
Tail (µm)	28.1 (26.3-29.4)	26.8 (23.1-29.4)	27.2 (27.0-28.0)
Width at anus (µm)	43.7 (42.0-46.2)	42.8 (42.0-45.2)	41.8 (41.0-42.0)
DN (%)	15.2 (13.8-16.7)	16.8 (15.1-17.5)	16.2 (14.8-18.2)
ASVGN (%)	77.6 (75.9-79.4)	76.0 (70.4-80.4)	73.1 (70.1-74.5)

* For abbreviations see text.

** Mean is given first followed by range in parentheses.

Table 3
Biometrics of *Californidorus clavicaudatus* n. sp. juvenile paratypes.

Measurements and ratios*	♂ 1 (n = 10)	♂ 2 (n = 10)	♂ 3 (n = 3)	♂ 4 (n = 10)
L (µm)	820.5 (760-861)**	1053 (998-1095)	1494 (1340-1642)	1949 (1659-2190)
a	39.3 (33.8-41.8)	39.5 (36.5-42.4)	42.4 (38.7-46.0)	45.0 (40.5-51.5)
b	3.06 (2.41-3.36)	3.31 (3.11-3.69)	3.71 (3.58-3.88)	4.19 (3.74-4.57)
c	15.6 (11.0-13.9)	37.0 (33.9-40.1)	57.0 (49.1-65.2)	67.6 (56.4-78.4)
c'	4.55 (3.86-5.08)	1.43 (1.30-1.56)	0.97 (0.86-1.08)	0.78 (0.66-0.85)
Odontostyle (µm)	38.6 (36.8-41.0)	50.1 (48.3-52.5)	69.0 (68.3-69.3)	84.5 (81.9-88.2)
Odontophore (µm)	31.8 (29.4-35.7)	59.5 (50.4-56.7)	69.6 (65.2-73.5)	76.3 (73.5-79.8)
Replacement odontostyle (µm)	49.6 (48.3-50.4)	67.2 (65.1-69.3)	86.1 (84.0-88.2)	103.0 (99.8-107.1)
GR (µm)	21.5 (21.0-22.0)	22.3 (21.0-23.1)	27.3 (26.3-28.4)	33.6 (32.5-35.7)
Esoph. (µm)	270 (249-315)	319 (281-337)	406 (374-423)	464 (435-485)
Widest width (µm)	20.9 (20.0-24.2)	26.7 (25.2-27.3)	35.7 (31.5-39.9)	43.3 (41.0-47.3)
Tail (µm)	65.7 (56.7-72.5)	28.6 (26.3-30.5)	26.6 (25.2-27.3)	28.9 (26.3-30.5)
ABW (µm)	14.5 (13.7-15.8)	20.1 (18.9-21.0)	28.0 (25.2-29.4)	37.2 (24.7-41.0)
Spike length (µm)	41.4 (33.6-46.2)	—	—	—

* For abbreviations see text.

** Mean is given first followed by range in parentheses.

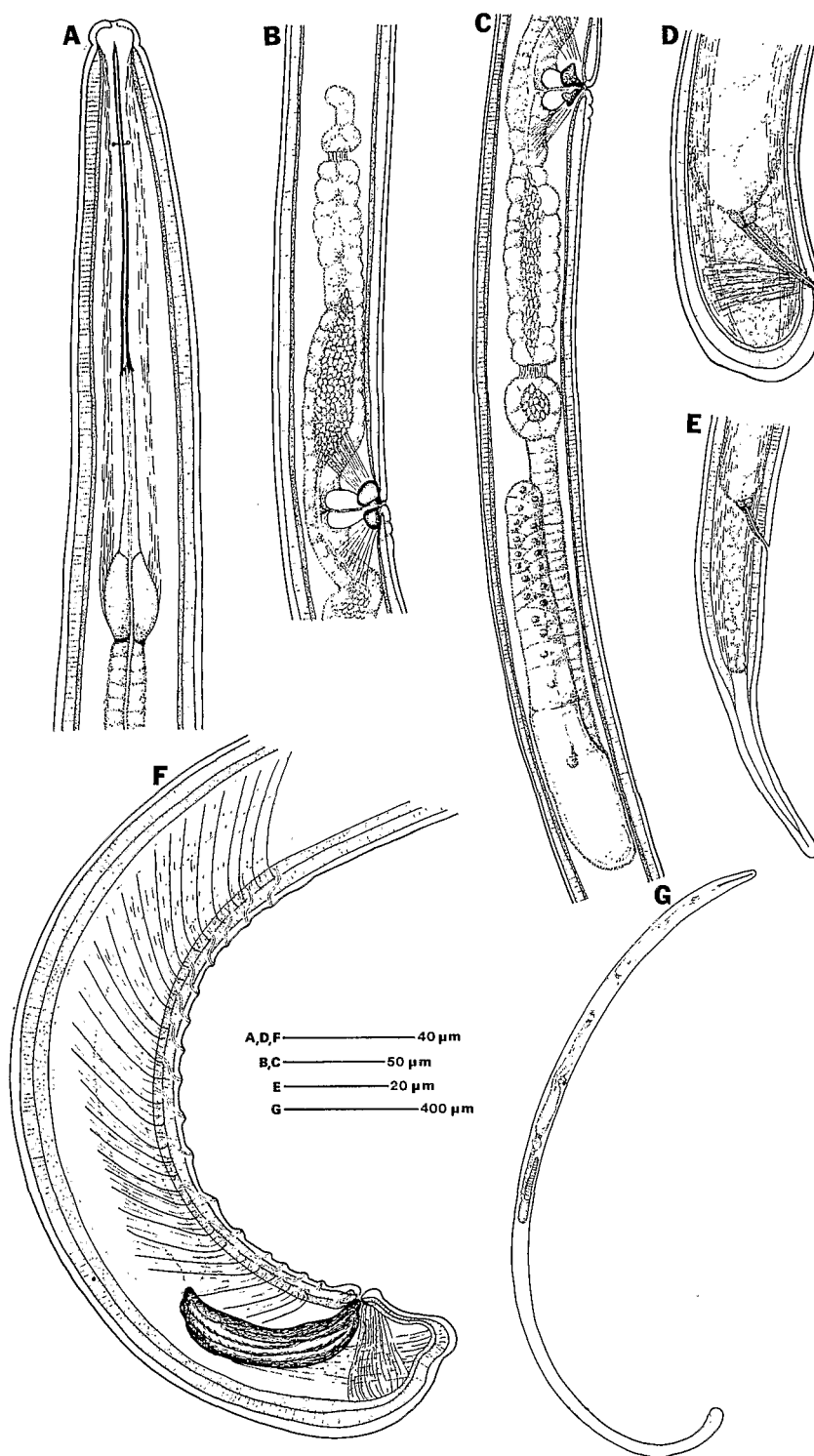


Fig. 2. *Californidorus clavicaudatus* n. sp. A : Female anterior region; B : Female anterior genital region; C : Female posterior genital region; D : Female tail; E : First-stage juvenile tail; F : Male tail; G : Entire female.

Paratypes : 5 females, 8 males, 39 juveniles (18 J1, 12 J2, 3 J3, 6 J4) : same data as holotype. *Paratypes* deposited as follows : 2 females, 3 males, 12 juveniles, University of California Davis Nematode Collection, Davis, California. One female, one male, 13 juveniles, Nematology Department, Rothamsted Experimental Station, Harpenden, Herts., England; 1 female, 3 males, 9 juveniles; USDA Nematode Collection, Beltsville, Maryland; 1 female, 1 male, 5 juveniles retained in author's collection.

DIAGNOSIS

Females of *C. clavicaudatus* n. sp. differ from *C. cralleyi* n. sp. and *C. cylindricaudatus* n. sp. by the swollen tail and longer anterior genital branch which usually contains sperm. Females of *C. clavicaudatus* n. sp. differ from *C. cralleyi* n. sp. by the vulval position (33-38 vs 40-50 %) and longer odontophore (80-88 vs 90-99 μm) and odontostyle (96-105 vs 102-112 μm). This species differs from : *C. cylindricaudatus* n. sp. and *C. pinguicaudatus* by the longer body; *C. cylindricaudatus* n. sp. by a longer odontostyle (87-95 vs 96-105 μm); and *C. pinguicaudatus* by possessing a reduced anterior genital branch (absent in *C. pinguicaudatus*) and by two or three ventral pores posterior to the vulva vs lack of pores. Males of *C. clavicaudatus* n. sp. differ from *C. pinguicaudatus* by the tail shape (knob-like ventral process vs bluntly rounded).

Table 4

Biometrics of *Californidorus cralleyi* n. sp. females.

Measurements and ratios*	Paratypes (n = 24)
L (μm)	2611 (2393-2887)**
a	46.8 (42.3-49.9)
b	4.87 (4.52-5.35)
c	87.3 (77.8-97.1)
c'	0.77 (0.71-0.89)
V	43.9 (39.9-49.5)
Lip W (μm)	16.0 (15.0-17.0)
GR (μm)	42.4 (40-44)
Odontostyle (μm)	107.3 (102-112)
Odontophore (μm)	94.7 (90-99)
EBL (μm)	224 (200-240)
EBW (μm)	27.8 (23-32)
Esoph. (μm)	538 (506-562)
Dist. to vulva (μm)	1144 (1003-1279)
Ant. gonad length (μm)	201 (170-238)
Post. gonad length (μm)	345 (280-462)
Vaginal depth (μm)	32.4 (29.0-37.0)
Width at vulva (μm)	55.8 (53.0-60.0)
Tail (μm)	30.0 (28.0-33.0)
Width at anus (μm)	38.9 (36.0-40.0)
DN (%)	17.0 (15.0-20.0)
ASVGN (%)	80.3 (76.6-85.0)

* For abbreviations see text.

** Mean is given first followed by range in parentheses.

Table 5

Biometrics of *Californidorus cralleyi* n. sp. juvenile paratypes.

Measurements and ratios*	♂ 1 (n = 15)	♂ 2 (n = 15)	♂ 3 (n = 15)	♂ 4 (n = 15)
L (μm)	875 (825-908)**	1094 (1030-1200)	1441 (1314-1532)	2012 (1790-2374)
a	38.7 (35.9-40.7)	38.0 (35.2-39.6)	42.2 (39.6-43.8)	46.2 (42.3-51.2)
b	3.16 (2.99-3.33)	3.35 (3.14-3.66)	3.61 (3.43-3.74)	4.22 (3.81-4.83)
c	11.3 (10.5-11.9)	34.6 (31.1-36.8)	46.0 (42.9-48.6)	64.3 (57.7-70.0)
c'	5.33 (4.93-5.90)	1.59 (1.45-1.75)	1.22 (1.15-1.33)	0.90 (0.84-1.00)
Odontostyle (μm)	46.1 (45.0-48.0)	58.1 (56.0-60.0)	76.0 (73.0-78.0)	92.1 (88.0-94.0)
Odontophore (μm)	56.2 (54.0-58.0)	62.5 (60.0-66.0)	76.9 (73.0-80.0)	84.3 (80.0-88.0)
Replacement odontostyle (μm)	58.1 (56.0-60.0)	76.0 (73.0-80.0)	91.8 (89.0-94.0)	105.7 (99.0-110.0)
GR (μm)	25.6 (24.0-27.0)	25.1 (24.0-26.0)	31.1 (30.0-32.0)	37.1 (35.0-39.0)
Esoph. (μm)	278 (256-290)	326 (296-354)	399 (360-429)	479 (460-494)
Widest width (μm)	22.6 (22.0-23.0)	28.8 (28.0-32.0)	34.2 (31.0-36.0)	43.5 (40.0-49.0)
Tail (μm)	77.3 (70.0-83.0)	31.7 (30.0-35.0)	31.4 (28.0-34.0)	31.3 (29.0-34.0)
ABW (μm)	14.6 (14.0-15.0)	19.9 (19.0-22.0)	25.6 (24.0-28.0)	34.9 (32.0-38.0)
Spike length (μm)	50.1 (46.0-54.0)	—	—	—

* For abbreviations see text.

** Mean is given first followed by range in parentheses.

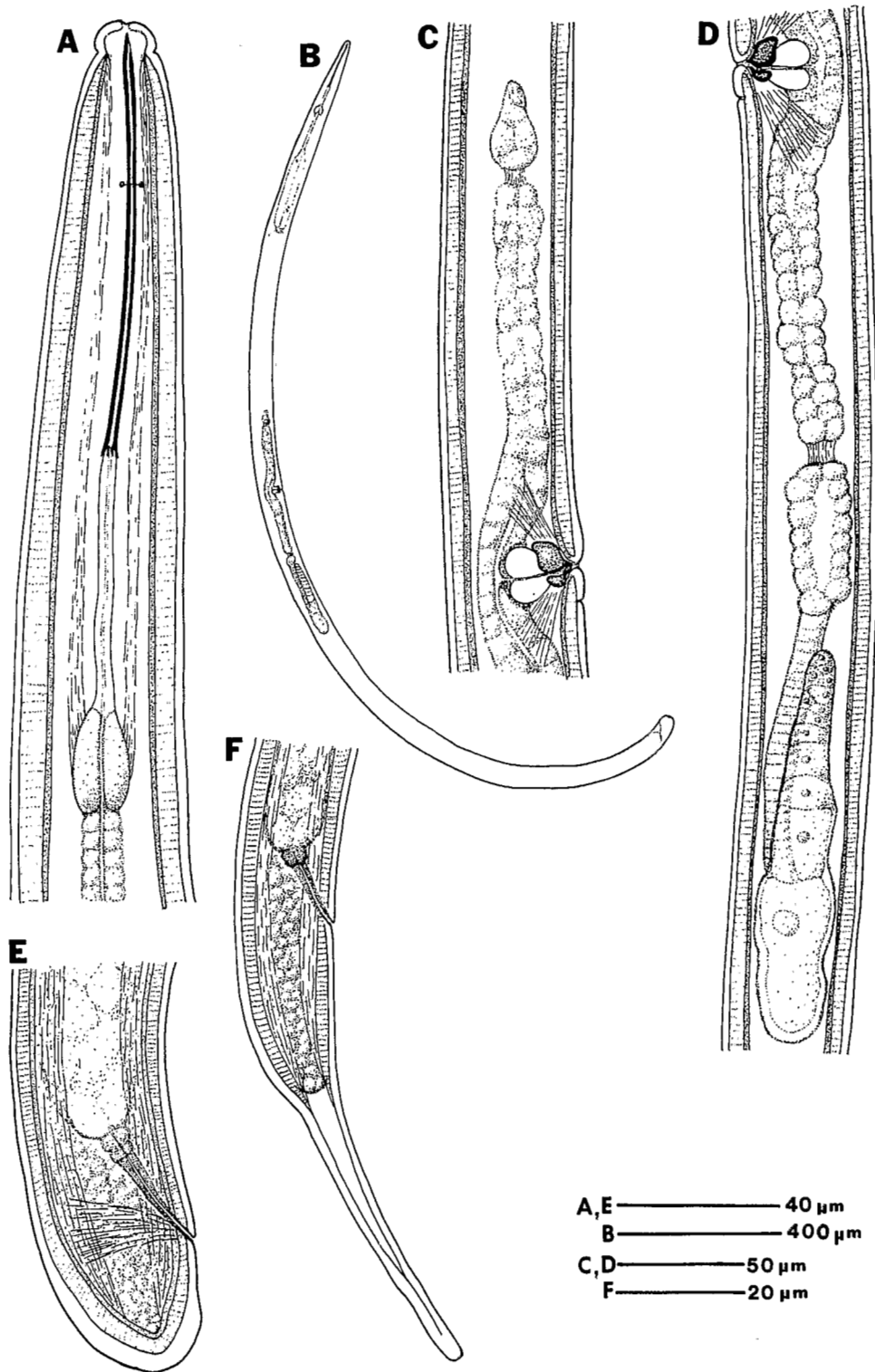


Fig. 3. *Californidorus crallei* n. sp. A : Female anterior region; B : Entire female; C : Female anterior genital region; D : Female posterior genital region; E : Female tail; F : First-stage juvenile tail.

Californidorus cralleyi* n. sp.
(Fig. 3)

MEASUREMENTS

Females : see Table 4.

Juveniles : see Table 5.

Holotype (female). L = 2.75 mm; a = 50.9; b = 5.11; c = 94.7; c' = 0.76; V = 41.4; odontostyle = 108 μ m; odontophore = 92 μ m; GR = 42 μ m; G₁ = 190 μ m; G₂ = 398 μ m; width = 54 μ m; esoph. = 538 μ m; tail = 29 μ m; ABW = 38 μ m; EBL = 223 μ m; EBW = 27 μ m; DN = 15.2 %; ASVGN = 79.8 %.

DESCRIPTION

Female : Body stout, ventrally curved, "C" to "J" shaped when killed. Lip region about twice as wide as high, rounded, offset. Amphidial openings and pouches typical for genus. Guide ring single, about 2 1/2 lip region widths from anterior end. Stylet as for *C. clavicaudatus* n. sp. but longer. Nerve ring and expanded basal portion of esophagus typical for genus. Vulva a transverse slit, with zero to three ventral pores just posterior to vulva (usually one). Distinct sclerotized "plates" anterior and posterior to vulva. Anterior genital branch reduced, not expanded, with sphincter at anterior end of uterus, greatly reduced terminal oviduct, no ovary. No sperm observed in uterus. Posterior genital branch typical of the genus, sac connecting the ovary and oviduct extends posterior to junction. Slightly flattened areas terminally on the bluntly rounded, cylindrical tail. One latero-dorsal caudal pore.

Male : None observed.

Juveniles : Typical for the genus.

TYPE HABITAT AND LOCALITY

Silt loam soil from about the roots of Red Haw (*Crataegus* sp. L.). In a wooded area about 1 1/2 km west and 10 km south of the Pine Tree Experimental Station Office, St. Francis County, Arkansas, USA. Only known from the type locality.

TYPE SPECIMENS

Holotype : Female. Collected October 1982 by R. T. Robbins. Deposited on slide number UCNC 2010,

* This species is named in honor of Dr. E. M. Cralley in recognition of his "White Tip" of rice control work in Arkansas.

University of California Davis Nematode Collection, Davis, California.

Paratypes : Numerous females and juveniles of all stages. Same data as holotype. Paratypes deposited in the following locations : University of California Nematode Collection, Davis, California; Department of Nematology Collection, University of California, Riverside, California; USDA Nematode Collection, Beltsville, Maryland; Nematology Department, Rothamsted Experimental Station, Harpenden, Herts., England; Laboratorium voor Nematologie, Wageningen, The Netherlands; Laboratoire des Vers, Muséum national d'Histoire naturelle, Paris, France; Canadian National Collection, Ottawa, Canada; Institut voor Dierkunde, Laboratorium voor Morfologie en Systematiek, Gent, Belgium; the remaining specimens retained in author's collection.

DIAGNOSIS

Females of *C. cralleyi* n. sp. differ from : *C. pinguicaudatus*, *C. clavicaudatus* n. sp. and *C. cylindricaudatus* n. sp. by the more posterior vulva; *C. pinguicaudatus* and *C. clavicaudatus* n. sp. by the greater distance to the guide ring and tail shape; and *C. cylindricaudatus* n. sp. by greater body length and longer odontostyle.

Californidorus cylindricaudatus n. sp.*
(Fig. 4)

MEASUREMENTS

Females : see Table 6.

Juveniles : see Table 7.

Holotype. Female : L = 2.07 mm; a = 43.0; b = 4.02; c = 68.1; c' = 0.83; V = 40.7; odontostyle = 92 μ m; odontophore = 92 μ m; GR = 40 μ m; G₁ = 124 μ m; G₂ = 358 μ m; width = 48 μ m; esoph. = 517 μ m; tail = 30.5 μ m; ABW = 35 μ m; EBL = 212 μ m; EBW = 28 μ m; DN = 14.9 %; ASVGN = 78.3 %.

DESCRIPTION

Female : Body stout, ventrally curved, "C" shaped when killed. Lip region about twice as wide as high, rounded, offset. Amphidial openings and pouches typical of the genus. Guide ring single, about three lip region widths from anterior end. Odontostyle long, with base forked at junction with odontophore; base of odonto-

* The species name *cylindricaudatus* is a compound Latin word derived from *cylindrus* = cylinder and *cauda* = tail.

Table 6
Biometrics of *Californidorus cylindricaudatus* n. sp. females.

Measurement or ratio*	Paratypes, Elm and Sweet Gum (n = 25)	Populations Hackberry and Grape (n = 16)	Osage Orange (n = 3)
L (µm)	2036 (1776-2466)**	1993 (1754-2129)	2165 (2077-2252)
a	40.8 (34.1-47.4)	38.5 (36.0-42.3)	41.8 (40.5-42.9)
b	4.21 (3.80-4.86)	4.07 (3.73-4.36)	4.27 (4.09-4.47)
c	68.2 (53.8-82.2)	67.0 (55.7-76.8)	75.7 (71.5-79.4)
c'	0.82 (0.64-0.92)	0.82 (0.72-0.94)	0.73 (0.67-0.79)
V	38.6 (34.6-40.8)	38.7 (35.1-41.5)	39.0 (38.0-39.9)
Lip W (µm)	13.9 (13.1-14.7)	13.5 (13.1-14.7)	13.5 (13.5-13.5)
GR (µm)	40.4 (37.0-45.0)	38.5 (36.8-39.9)	40.3 (40.0-41.0)
Odontostyle (µm)	90.5 (87.0-95.0)	92.6 (88.2-95.6)	94.2 (92.5-95.0)
Odontophore (µm)	90.3 (86.0-96.0)	86.7 (83.0-94.5)	89.7 (84.0-92.5)
EBL (µm)	205 (187-223)	210 (185-227)	206 (202-215)
EBW (µm)	25.6 (22.1-29.4)	23.2 (21.0-26.3)	25.0 (24.0-26.0)
Esoph. (µm)	492 (373-523)	489 (464-533)	507 (504-508)
Dist. to vulva (µm)	795 (682-884)	772 (659-873)	844 (811-865)
Ant. gonad length (µm)	176 (160-240)	179 (147-218)	169 (164-174)
Post. gonad length (µm)	337 (262-515)	338 (288-374)	409 (384-454)
Vaginal depth (µm)	30.5 (29.4-33.6)	31.2 (28.4-33.6)	31.2 (29.5-32.5)
Width at vulva (µm)	50.5 (47.0-54.0)	51.8 (48.3-54.6)	51.8 (49.5-53.5)
Tail (µm)	30.3 (27.0-33.0)	29.9 (26.3-34.7)	28.8 (27.5-31.5)
ABW (µm)	37.3 (33.0-42.0)	36.7 (34.7-38.9)	39.3 (37.0-41.0)
DN (%)	16.7 (15.5-17.9)	18.8 (15.9-22.9)	15.9 (15.6-16.6)
ASVGN (%)	79.5 (78.0-81.5)	80.3 (76.6-82.3)	77.7 (74.5-80.9)

* For abbreviations see text.

** Mean is given first followed by range in parentheses.

Table 7
Biometrics of *Californidorus cylindricaudatus* n. sp. juvenile paratypes.

Measurements and ratios*	♂ 1 (n = 18)	♂ 2 (n = 15)	♂ 3 (n = 15)	♂ 4 (n = 15)
L (µm)	765 (676-826)**	887 (817-960)	1166 (1063-1308)	1518 (1340-1657)
a	37.6 (34.7-39.2)	35.9 (33.9-37.3)	38.0 (35.8-40.9)	39.9 (37.3-42.5)
b	3.10 (2.95-3.30)	3.05 (2.90-3.29)	3.26 (2.84-3.58)	3.53 (2.94-3.85)
c	9.30 (8.53-10.33)	30.2 (28.3-34.1)	38.0 (35.2-40.9)	51.1 (46.8-61.4)
c'	6.44 (5.71-7.17)	1.76 (1.50-2.00)	1.39 (1.27-1.60)	0.99 (0.88-1.11)
Odontostyle (µm)	36.5 (35.0-38.0)	46.7 (45.0-48.0)	61.9 (59.0-66.0)	75.7 (73.0-78.0)
Odontophore (µm)	35.3 (31.5-42.0)	52.7 (50.0-55.0)	65.8 (62.0-69.0)	76.6 (72.0-81.0)
Replacement odontostyle (µm)	46.5 (45.0-48.0)	61.9 (58.0-65.0)	74.1 (72.0-77.0)	87.1 (84.0-90.0)
GR (µm)	20.4 (19.5-22.5)	20.8 (20.0-22.0)	27.2 (26.0-31.0)	32.9 (31.0-34.0)
Esoph. (µm)	245 (222-269)	291 (278-310)	358 (330-396)	430 (386-470)
Widest width (µm)	20.4 (19.5-22.0)	24.8 (23.0-27.0)	30.7 (28.5-33.0)	38.0 (33.5-41.0)
Tail (µm)	82.4 (70.0-88.0)	29.4 (27.0-33.0)	30.7 (28.0-33.0)	29.7 (24.0-33.0)
ABW (µm)	12.8 (12.0-14.0)	16.7 (15.0-18.0)	22.1 (20.0-24.5)	29.9 (25.0-33.0)
Spike length (µm)	57.3 (47.0-64.0)	—	—	—

* For abbreviations see text.

** Mean is given first followed by range in parentheses.

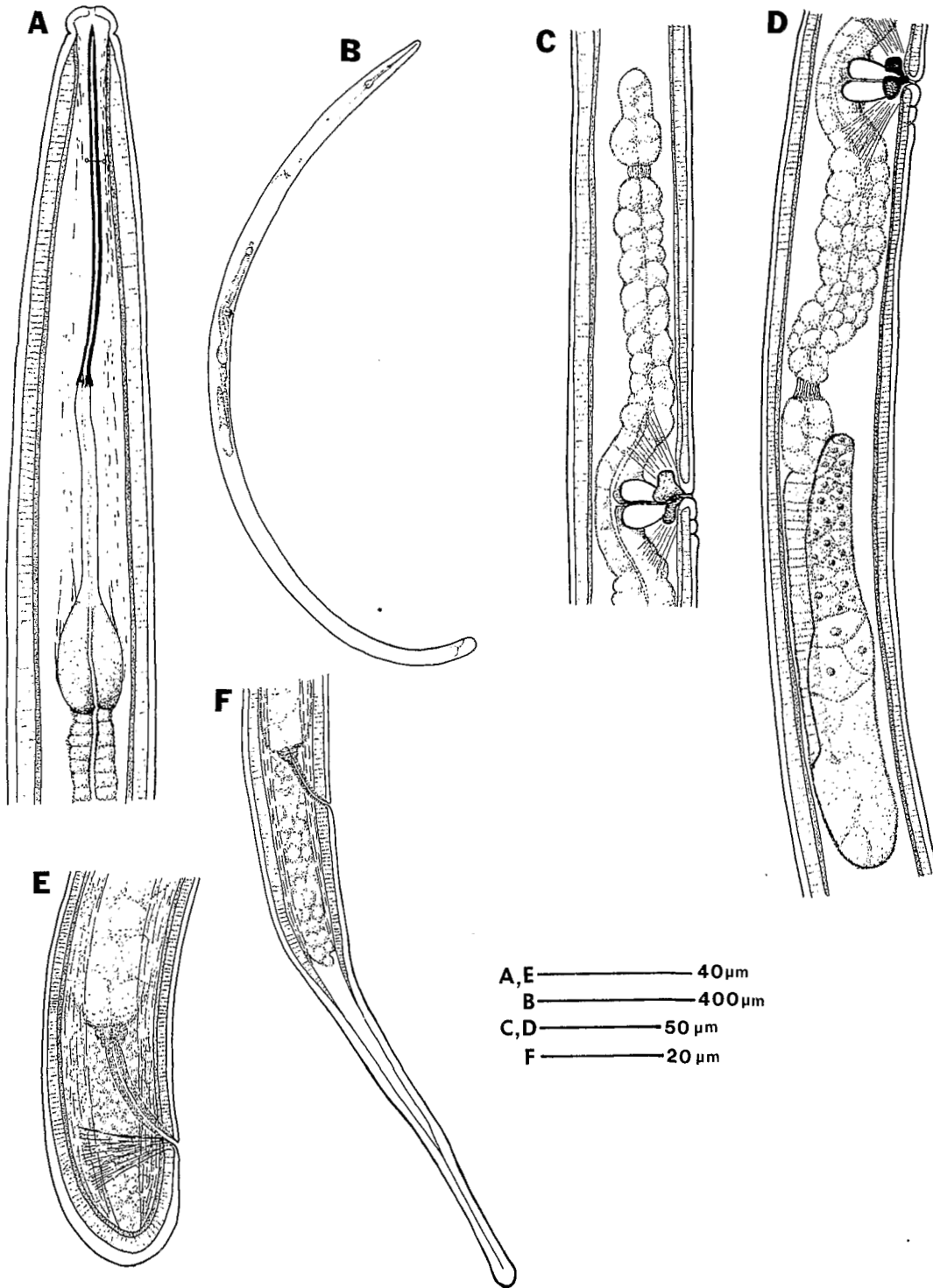


Fig. 4. *Californidorus cylindricaudatus* n. sp. A : Female anterior region; B : Entire female; C : Female anterior genital region; D : Female posterior genital region; E : Female tail; F : First-stage juvenile tail.

phore expanded, moderately sclerotized. Nerve ring and expanded basal portion of esophagus typical for genus. Vulva a transverse slit, one, two, or three ventral pores just posterior to vulva. Distinct sclerotized "plates" posterior and anterior to vagina. Anterior genital branch reduced, uterus narrow, sperm not observed, sphincter at uterus terminus, oviduct reduced with ovary absent. Posterior genital branch reflexed near oviduct-ovary junction, connecting sac extends posterior to junction. Tail cylindrical, bluntly rounded, hemispherical, smooth, with two latero-dorsal caudal pores.

Male : None observed.

Juveniles : Typical for the genus.

TYPE HABITAT, TYPE LOCALITY AND DISTRIBUTION :

Sandy soil from about the roots of elm (*Ulmus americana* L.) and sweet gum (*Liquidambar styraciflua* L.) growing on the east bank of the Middle-Fork of the White River, about 50 meters north of the bridge crossing the river approximately 8 km south of Highway 16, Washington County, Arkansas.

Found also about the roots of cane (*Arundinaria gigantea* (Wat.) Chapm.), silver maple (*Acer saccharinum* L.), cottonwood (*Populus deltoides* Marsch.), and sycamore (*Platanus occidentalis* L.) in the type locality. Found about the roots of cedar (*Juniperus virginiana* L.), grape (*Vitis* sp.) and hackberry (*Celtis* sp.) near the type locality of *C. clavicaudatus* on Dick's Branch in Johnson County Arkansas. Also found south of the bridge on Old Missouri Road in Fayetteville, Washington County, Arkansas, about the roots of osage orange (*Maclura pomifera* (Raf.) Schneid) and wild cherry (*Prunus serotina* Ehrh.).

TYPE SPECIMEN

Holotype : Female : Collected October, 1979 by R. T. Robbins and M. L. Hamblen. Deposited on slide number UCNC 2013, University of California Davis Nematode Collection, Davis, California.

Paratypes : Numerous females and juveniles of all stages. Same data as holotype. Paratypes deposited in the following locations : University of California Davis Nematode Collection, Davis, California; University of California, Riverside, California; USDA Nematode Collection, Beltsville, Maryland; Nematology Department, Rothamsted Experimental Station, Harpenden, Herts., England; Laboratorium voor Nematologie, Wageningen, The Netherlands; Laboratoire des Vers, Muséum national d'Histoire naturelle, Paris, France; Canadian National Collection, Ottawa, Canada; Instituut voor Dierkunde, Laboratorium voor Morfologie en Systematiek, Gent, Belgium; the remaining specimens are retained in the author's collection.

DIAGNOSIS

Females of *C. cylindricaudatus* n. sp. differs from : *C. pinguicaudatus* and *C. clavicaudatus* n. sp. by its cylindrical tail shape, and a shorter odontostyle; and *C. cralleyi* n. sp. by its more anterior vulva.

Discussion

Females of the three *Californidorus* spp. found in Arkansas all have a reduced anterior genital branch (AGB) and ventral pore(s) posterior to the vulva. *C. pinguicaudatus* found in California has no ventral pores posterior to the vulva and usually no AGB. A single specimen was found to have reduced AGB (Robbins & Weiner, 1978).

While no males of *C. cylindricaudatus* n. sp. were observed, a single female of this species was found in a mixed population of *C. cylindricaudatus* n. sp. and *C. clavicaudatus* n. sp., with sperm present in both uteri. This may indicate that hybridization between these two species is possible.

Sclerotized "plates" were found in all female specimens observed of the three species in which males are lacking or rare. These structures were often either not distinguishable or absent in the bisexual species *C. clavicaudatus* n. sp. The J1 of the Arkansas species are readily distinguished from each other by comparing spike length, tail length, replacement odontostyle length, odontostyle length, and body length. Two J2 of *C. cylindricaudatus* were found to have abnormal tails, one is pointed and about 14 μ m longer than the mean tail length while the second is conical-rounded *vs* the normal bluntly-rounded.

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Accepté pour publication le 23 mai 1985.